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Edited by

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EDITORIAL.

SHOT-HOLE BORER INVESTIGATIONS.

It became evident during discussion at the Conference held at St. Coombs in March last, that there is considerable difference of opinion regarding the importance of Shot-hole borer as a pest and the damage it causes. The Experimental Committee of the Institute later considered this matter and made certain recommendations to the Board, which decided:—

> 'That through the agency of the District Planters' Associations, the Institute should be informed of those estates on which Shot-hole borer was regarded as being the cause of serious crop losses; that the Institute should ask permission to investigate the records of those estates first of all in general by correspondence and questionnaire, and then personally in detail, to ascertain the facts about crop losses.'

The success of an investigation of this nature is dependent upon the co-operation of estate managements. Without their help, failure is inevitable. Both the Planters' Association and the Ceylon Estates Proprietary Association have expressed their willingness to co-operate fully, and judging from past experience we feel assured of the necessary assistance of estate managers. The object of this note then, is to draw attention to the enquiry and to explain our requirements and intentions.

It may seem strange at this late date in the history of Shot-hole borer in Ceylon, that there should be any difference of opinion concerning the importance of this pest and the crop losses it may cause. A difference of opinion on such matters implies an incomplete knowledge of the subject on one or both sides. The Institute, here and now, admits that its knowledge of the subject is far from complete; it also realises that there may be within the knowledge of estate superintendents many facts concerning Shot-hole borer, of which the scientists remain in complete ignorance. The object of the investigation is not to accumulate a mass of new evidence in the first place, but to make the fullest use of what is at present in existence. Much of it is buried in estate records. We hope that these investigations will remove at least some of the questions in dispute from the realm of opinion to that of demonstrable fact.

The question whether Shot-hole borer causes material reduction in crop appears at first sight to be one easy to determine: an examination of crop records should provide the answer. The solution of the problem obviously cannot be as easy as that, otherwise there could be no difference of opinion on the matter.

Crop is influenced by many factors of which only climate and cultivation need be mentioned here. Crop also gives a reflection of many bush characteristics. For instance, it is difficult to imagine a general reduction in the size of the tea bushes (their frames) or a reduction in the vitality or general health of the bushes which would not have an adverse effect on the crop. Different factors may be operative simultaneously and tend to influence crop yields differently. Thus, climate and increased manuring may simultaneously tend to increase yields, yet at the same time a reduction in the size of the bushes owing to the ravages of Shot-hole borer may be operative The ultimate result may be an increase in yield, yet, by hypothesis, the agency of Shot-hole borer has nevertheless caused a reduction in crop. Much of the damage caused by Shot-hole borer may thus be masked by the beneficial influence of other factors. This masking is likely to occur whatever criterion is used for measuring the effect of the pest. The only estate records which are likely to throw any light on the problem are crop records, and these must be studied with other records such as manurial programmes in order to obtain a true picture of the position.

Another possible cause of the difference of opinion is that the material damage caused by Shot-hole borer varies in different districts because of different climatic conditions. For that reason, the enquiry should cover a wide area and not be restricted to any particular district.

For such reasons as the above, it was considered advisable to begin enquiries on those estates on which, in the opinion of the management, Shot-hole borer causes serious crop losses. Superintendents of such estates are requested to inform their District Planting Associations or the Tea Research Institute direct of their willingness to co-operate in these investigations. To such estates in the first place will be sent a questionnaire asking for specific information, much of which can be extracted from estate records. This information will be regarded as confidential if so desired.

The Board's intention was not that the investigations should cease when the data obtained from questionnaires are analysed, but that any points emanating from such analyses shall be followed up 'personally in detail.' The investigation will start with examinations of crop records, but the lines along which it will travel later

will depend to a large extent upon the facts or indications which emerge from the study of data. Crop records obviously form the most suitable starting point as every estate has accurate records going back many years. The aim and object of the investigation, however, is to eliminate opinion concerning the ravages of Shot-hole borer and to replace it by demonstrable facts. Obviously, that purpose cannot be achieved by restricting the scope of the investigation to crop records alone.

It is hoped that this note will remove any misapprehension that may exist regarding the scope of the investigations. The success of the investigation is largely dependent upon the active co-operation of the planting community. We ask for that co-operation and an opportunity of examining the data on which current opinion is founded.

C. H. GADD,

THE VALUATION OF MANURES

T. EDEN

On account of the war, estates have been unable to obtain the standard manure mixtures that have been in constant use over a number of years. Instead they have been offered a variety of substitutes which have frequently been the subject of correspondence with the Institute. This correspondence has shown that manure mixture prescriptions are still something of a mystery in certain quarters, and that the attitude adopted towards them is sometimes not unlike that adopted towards the prescription for a bottle of medicine. It is prescribed by a specialist of one sort, dispensed by a specialist of another sort, and used at the stated dose without further question.

Changes in manurial prescriptions are bound to occur during wartime according to the immediate exigencies of the fertilizer situation. There is thus all the more reason why superintendents and others should have a rudimentary knowledge of the interpretation of manurial recipes, in order that the records kept by estates, which are presumably meant to convey definite information, should remain consistent and intelligible. Perhaps present day conditions will make it clear that '300 lbs. of manure' means about as much or as little as '300 lbs. of coins.' Neither phrase conveys any information about the value of either the manure or the coins.

At any given time the value of a coin depends on how much gold it can be exchanged for. The price of that gold is independent of whether it is contained in ingots or coins or jewelry. An ounce of commercial gold of the 18-carat standard in the form of a bracelet will fetch double the price of an ounce of 9-carat gold in the form of a watch-case simply because the former contains twice as much pure gold. The carat scale commonly used is similar to the percentage scale, but is graduated in twenty-fourths instead of hundredths.

Similarly the real value of manures depends upon the percentage of the nutrient they contain; here the analogy with the coin or jewelry is complete. But unlike articles of commercial gold, the price paid for the essential constituent, *i.e.*, nitrogen, phosphoric acid and

potash, is not independent of the form in which it is sold. For example a higher price will be asked for nitrogen in the form of blood meal than for an equivalent amount of nitrogen in the form of sulphate of ammonia. From this it will be clear that the price comparison of manures must centre round two questions;

(1) How much actual nutrient do they contain, or conversely how much of their bulk is inevitable make-weight?

(2) How much is being paid for a standard amount of the nutrient they contain ?

By way of illustration we may take those fertilizers which are commonly used entirely for the sake of one nutrient. Table I gives a list of these together with their percentage composition with respect to the nutrient required, and the price per ton. For the purposes of this article the prices are merely illustrative and are not meant to reflect exactly prevailing prices, which at times like these are subject to fluctuations consequent on market conditions.

TABLE I.

Composition and Prices of Simple Fertilizers.

Fertilizer	Price per ton Rs.	Percentage composition Nitrogen	Phos. Acid	Potash	Unit Price Rs.
Sulphate of ammonia	206	20.6	—	—	10
Nitrate of soda	192	16.0	—	—	12
Blood meal	190	11.0	—	—	17.3
Castor cake	90	4.0	—	—	22.5
Groundnut Cake	98	7.0	—	—	14.0
Mineral Phosphate	83	—	29.5	—	2.8
Conc. Superphosphate	190	—	42.0	—	4.5
Ordy. ,,	95	—	18.0	—	5.3
Muriate of Potash	185	—	—	50.	3.7

From this table, it is evident that 100 lbs. of sulphate of ammonia contributes much more nitrogen than any of the rest of the nitrogenous manures in the list, as much in fact as 300 lbs. of groundnut cake or 500 lbs. of castor cake. This is the only criterion by which the relevance of '300 lbs. of manure' can be judged. Because of this variability in composition, price per ton is no help in assessing the

value of a manure either plain or mixed. Before such an assessment can be made, it is necessary to reduce the prices to a comparable basis. That in general use is the 'unit price' which is defined as the price of 1/100 ton of the *nutrient* (not 1/100 ton of the fertilizer). The figure 1/100 ton or 22.4 lb. may at first sight seem an awkward one to work with, in comparison with some convenient round figure such as 20 or 100. Actually, it is specially convenient because the unit price is arrived at simply by dividing the price per ton by the percentage composition. In other words, a manure containing five per cent of nitrogen, phosphoric acid or potash contains five units of that element per ton.

The final column of Table I gives these unit prices, *i.e.*, the cost of 22.4 lb. of nitrogen, phosphoric acid or potash in each particular manure. There is considerable variation. At the prices per ton in the list, it pays to buy nitrogen as sulphate of ammonia in preference to any other sort, and to buy mineral phosphate rather than superphosphates. Buyers of fertilizers will have noticed that since sulphate of ammonia was rationed, the balance of nitrogen in mixtures has been made up largely from groundnut cake or nitrate of soda. The unit price table supplies the reason for this. Nitrate of soda and groundnut cake have been the cheapest alternatives to sulphate of ammonia, and have been used according as the one or the other was more readily procurable at the time of order.

The unit value principle can be applied in respect of individual nutrients to fertilizers containing more than one nutrient such as the combined nitrogen and phosphoric acid fertilizers shown in Table II. In this group the unit prices of phosphoric acid have been chosen for determination.

TABLE II.

Composition and Prices of Compound Fertilizers.

Fertilizer	Price per ton Rs.	Percent Nitrogen	Percent Phos. Acid	Unit price of phosphoric acid based on N as :— S/Am.	N/Soda	G.N.C.
Bone Meal	90	3	22	2.7	2.45	2.2
Fish Guano	140	7	6	11.7	9.3	7.0
Crushed Fish	90	4	4	12.5	10.5	8.5

Part of the value of these manures is due to the nitrogen and part to the phosphoric acid they contain. Before evaluating phosphoric acid, therefore, the value of their nitrogen must be determined

and then deducted from the price per ton. In the first place let us value the nitrogen as we normally should, in terms of the cheapest form we might use as a substitute. Now one ton of bone meal (N. 3 per cent) contains three units of nitrogen. Valued as sulphate of ammonia this is worth three times the unit price of nitrogen in sulphate of ammonia given in Table I, viz. Rs. 30. The cost of the phosphoric acid per ton in bone meal is accordingly Rs. $90-30=$ Rs 60 and the unit price of phosphoric acid one twenty-second of this, *i.e.*, Rs. 2.7.

If instead of valuing the nitrogen at its price as sulphate of ammonia, we had valued it as nitrate of soda, the unit price for phosphoric acid would have decreased to Rs. 2.45. Similarly on the basis of nitrogen as groundnut cake, the unit value of phosphoric acid in bone meal would be Rs. 2.2. The basis on which to value the complementary nutrient before calculating the unit price of phosphoric acid will depend on circumstances. At the present time when our choice of nitrogenous manures is limited, it is of little use taking the sulphate of ammonia figure. The choice of nitrogen as sulphate of ammonia is academic, because of the quota imposed on sulphate of ammonia. The chief point is that bone meal phosphoric acid can compare with mineral phosphate phosphoric acid in value no matter what alternative sources of nitrogen we might turn to in order to replace the nitrogen of bone meal. It will be impossible to use bone meal entirely to make good the nitrogen deficit caused by the sulphate of ammonia quota, because this would lead to mixtures with unreasonably high phosphoric acid contents, but the fact remains that in bone meal we get our phosphoric acid cheaply without paying an exorbitant price for our nitrogen also. In the case of fish guano and crushed fish, the unit price of phosphoric acid is definitely unattractive. A much more economical way of supplying the same quantities of nutrient would be to use a mixture of mineral phosphate with any of the three quoted nitrogenous manures.

When mixtures providing equivalent nutrient levels vary in constituents they frequently vary also in bulk, which affects transport charges. In general, if the choice lies between a more bulky fertilizer with low unit cost, and a less bulky fertilizer with a higher unit cost, the advantage usually lies with the former. It is generally convenient to compare costs of fertilizers in such a way that the comparable figures take into account differences in bulk and transport costs. The final criterion is naturally what the fertilizers will cost on the estate. Such a comparison can be made on the basis of the cost per acre. Three mixtures for demonstration are given in Table III.

TABLE III.

Alternative Mixtures of Varying Composition.

	Mixture A lb.	Mixture B lb.	Mixture C lb.
Sulphate of Ammonia ...	80	80	80
Nitrate of Soda ...	80	80	80
Groundnut Cake ...	150	—	—
Whale Guano ...	—	150	—
Blood Meal ...	—	—	100
Saphos ...	100	70	100
Muriate of Potash ...	40	40	40
Total ...	450	420	400
Nitrogen ...	39.78	39.78	40.28
Phosphoric Acid ...	29.50	29.65	29.50
Potash ...	20.00	20.00	20.00
Price per ton Rs. ...	*139*	*158*	*162*

Assuming that the cost of transport is Rs. 20 per ton, the cost per acre for the quantity given in the prescription is arrived at by a simple calculation of which the following is an example :—

$$\text{Mixture A} \quad \frac{(\text{Rs. } 139+20)\ 450}{2240} = \text{Rs. } 31.95$$

The corresponding costs for B & C mixtures are Rs. 33.4 and Rs. 32.5 respectively. These prices agree with the general rule quoted above, since the bulkiest mixture A is nevertheless the cheapest on the estate because its constituents have favourable unit prices.

To sum up, a knowledge of unit values enables those concerned to prescribe mixtures of suitable composition at the most reasonable costs, and to compare and, if necessary, modify alternative prescriptions.

NOTES ON THE SHOT-HOLE BORER OF TEA

Xyleborus fornicatus Eichhoff *fornicatior* Eggers

C. B. REDMAN KING, M.A., M.C.

1. NOMENCLATURE

At one time the Shot-hole borer of tea was named simply *Xyleborus fornicatus* by Eichhoff and the beetle was thought to have a wide variety of host plants, including castor and tea. It is now known that the beetle which commonly attacks castor is not the same as that which, in Ceylon, commonly attacks tea. The two are certainly very much alike to look at, and it would be extremely difficult from the examination of a single specimen to say by its appearance which species it was.

On biological grounds, however, the distinction is quite clear, since the tea borer does not attack castor ; and while the castor borer may attack tea to a slight extent, it only does so in the vicinity of attacked castor plants. For this reason it was desirable to give the former the distinctive sub-specific name as above, that for castor being *X. fornicatus fornicatus* Eichh.

2. THE FAMILY *SCOLYTIDAE*

In order to appreciate the economic significance of the tea shot-hole borer, it will be instructive to look at it against the background of the family to which it belongs, and which is commonly referred to as "Bark borers."

The family is a very large one, containing thousands of species, many of which are very common. Nearly all of them attack woody plants, mainly trees. Many are serious pests. They concern the forester very closely and compel him to incorporate into his routine, methods designed to alleviate the damage they may cause. It is our purpose to examine this damage.

Stands of trees are planted by the forester for economic reasons. Sometimes they are of one variety. They are allowed to grow for a certain term of years before being judged fit for market and

felled. During this period, some may get damaged in one way or another, others may become unthrifty. Wherever there are dead or dying branches, bark borers begin their attack. If allowed to persist, they not only reduce the quality of the timber by the galleries they make, but increase their population to such an extent that when the timber is felled the new generations of beetles attack it wholesale. Therefore, the forester must be continually cleaning up, cutting away dead branches and perhaps removing altogether unhealthy trees. When the time for felling arrives, he knows that the timber will soon become the prey of these beetles — some attack almost at once, others wait for varying intervals of time until chemical decomposition in the sapwood has proceeded sufficiently far for their particular desires — so he arranges for the disposal of the logs as soon as possible.

The damage which the forester fears is that due to the borings of the beetles, which renders the timber unfit for constructive purposes. If tea branches were valuable timber, then shot-hole borer could be described as a very serious pest.

Another type of damage which also depreciates his timber is the development of rots into the heart wood from snags, broken branches and wounds in the bark, which make tree surgery so important a part of his duties.

In text books on forestry, forest entomology and other publications on these subjects I have nowhere seen it suggested that the development of rots in trees ensues from the gallery systems of bark borers. Both are so common that there is no doubt whatever that if such a relationship exists it could not have been overlooked. It is necessary to stress this point, since it is held strongly by some that the wood-rot which is so common in tea is due chiefly, if not entirely, to the ravages of shot-hole borer. This point will be discussed later in greater detail.

The forester, then, has a good deal to contend with from the borings of different species of beetles, and the only means of dealing with them at his disposal lies in attention to the trees, and not in an attempt to control the beetles themselves, for there is no established method of doing so. Nor does nature help very much in the matter of parasites and predators. Of the thousands of species of this family which have been described, there are perhaps a couple of dozen known to be attacked by parasites or predators. The former are hymenopterous, the latter either beetles or flies, but not one of them has a controlling effect in the economic sense.

We may sum up the position regarding the family *Scolytidae* by saying that it is a very extensive family of bark-boring beetles,

containing thousands of different species, many of which are serious pests of forest areas throughout the world. Their importance is in proportion to the damage they do to otherwise saleable timber by their gallery systems. Attacks are mostly confined to dead or dying logs and branches, and the forester can only cope with the damage by hygienic sylvicultural methods. Few natural enemies are known, and they are of little economic importance.

3. SHOT-HOLE BORER AND BIOLOGICAL CONTROL

The tea shot-hole borer is a member of the family *Scolytidae* and the general remarks on biological control mentioned above apply with special force to *X. fornicatior*, since no natural enemy has so far been discovered. It is proposed now to discuss the probabilities of doing so.

In order to examine the situation intelligently, we must again consider generalities, and so for convenience we will divide parasites (including predators) as a whole into 2 classes.

1. Those which attack only one species of host.
2. Those which attack several species of hosts.

Parasites which belong to group 1 are very greatly outnumbered by those in group 2, but the only great successes in the application of the principles of biological control have been won with these forms in, or tending towards, group 1. As far as numbers go, the parasites are dependent on the population of the host. When the latter becomes rare, the parasite becomes rarer still. Therefore, from the point of view of survival, the parasite is running a risk in attaching itself to one host alone. On the other hand, the group 2 species spread their risk over several hosts, as a wise man spreads his savings over different classes of investment. The effect on any one host, however, will naturally be less marked. For this reason, when searching for an effective parasite, one looks for one which shall be as specific as possible on the host in question. The alternative is to obtain several parasites which attack the host.

As regards the tea shot-hole borer, we start at a disadvantage. No parasite of the tea shot-hole borer is known in any country where shot-hole borer exists. What then is the next step ? We must look for closely related beetles which act in a manner similar to the shot-hole borer. Already the scope of the enquiry is greatly narrowed, for very few borers behave like our shot-hole borer. The majority of the genus *Xyleborus*, like the great bulk of the family, bore into the trunks of trees which are dead or dying. Some bore into the smaller stems and branches of shrubs which are mostly dead. The nearest relation of the tea borer is the castor beetle,

but no parasites are known of this variety, either. Then there is the species *X. morigerus*, a coffee borer, which has been known to attack the roots of tea seedlings and withered tea twigs in Java. No parasites have been reared from it from tea, but at least one species of parasite has been recorded from it on coffee. Its relationship to the tea plant makes it improbable that the parasite could adapt itself to the habits of *X. fornicator*, and it is significant that not only has this species not yielded any parasite in Java, but that *X. morigerus* is not parasitised while attacking tea. Other species of *Xyleborus* are in no better case.

All species of this genus and for that matter, of many other genera, are highly specialised in that they carry about with them the spores of a particular fungus upon which they feed in their galleries. These fungi are apparently all different and not interchangeable. The conditions of growth for each are severely limited, and the propagation of the beetle is bound up with the success of the growth of the fungus. It may here be instanced that although our shot-hole borer may often bore into all sorts of trees and shrubs, it is only in tea and *Mimosa bracaatinga* and in one case, a recently dead rubber stem, that the fungus can grow and permit the beetle to raise a new brood. This specificity is associated with the environment which includes (in this case, excludes) parasitic fauna

It is hardly surprising, therefore, that the outlook for finding some insect enemy to deal with the problem is very far from promising. The success which attended the introduction of *Macrocentrus homonae* against Tortrix seems to have led some to think that what can be done for one pest can also be done for another. Nothing could be further from the truth. There is no analogy whatsoever in the two cases. Every instance of attempted natural control must be considered strictly on its own merits, and this applies as much to closely related species where probabilities can be more easily estimated, as to those with little or no relationship at all.

The tea shot-hole borer has been established in Ceylon for some fifty years. In that period no parasite or predator has been found, and it may be noted that for some years the Department of Agriculture had a special officer working on it. We can take it therefore that nothing is to be gained from any intensive research on the matter in Ceylon. In India, the pest has been up to now unknown in the North-East, and only known recently in South India in a very small area. It is listed both in Java and Formosa, but in none of these countries is it reckoned of importance, with the result that not much is known about it there. The idea of sending someone to investigate the matter in one of these countries has been raised more than once, but the terms of reference would at once be a

matter of difficulty since a time limit would be necessary if expenses were to be kept within bounds, and there is no available evidence to show what period of time might be expected to yield fruitful results.

4. SHOT-HOLE BORER AND WOOD-ROT

Organisms which are responsible for wood-rot in tea bushes attack the heart wood of the branches, access to which must be direct, through wounds, or through dead branches. They are unable to penetrate healthy bark. If the tea bush were allowed to grow as nature intended, into a tree, the chances offered to these organisms by way of wounds, directly to the internal woody parts, would be far less than it is. But the plant is not allowed to grow into a tree. Every two, three or four years it is ruthlessly cut down, each time presenting new surfaces to infection. The shorter the pruning cycle, therefore, the more is the risk incurred of wood-rot developing. In fact, wood-rot is the commonest ailment that the tea bush suffers in all situations, and it certainly cannot be said that it is due entirely to shot-hole borer, since it occurs where the borer is not to be found.

However, it is sometimes averred that shot-hole borer is responsible for a great deal of wood-rot, and the questions to be examined are :—

(a) Whether the beetle contributes anything at all to wood-rot, and

(b) If so, how much.

The spores of wood-rotting fungi must be in contact with the heart wood of the bush. The shot-hole beetle may expose this wood by means of gallery formations, or by breakage of a branch due to weakness caused by the presence of a gallery. Thus a fungus may gain entry in one of the three following ways :—

(1) Spores may drift into a borer gallery.

(2) They may be carried in on the body of the beetle.

(3) They may catch on the rough surface of a branch where it breaks.

The first two points can be discussed together, and imply that wood-rot may start from a gallery. It is well known that the beetle carries about with it the spores of a particular species of fungus, known as "ambrosia," which in suitable conditions grows on the walls of the galleries and provides food for both young and adults. It is also recognised that the wood round the galleries becomes

stained some darker colour. It is asserted by some that this stain develops into wood-rot which in turn eventually destroys the bush. Naturally, any fungus growing in such a site falls under suspicion. Fungi isolated from the wood surrounding borer galleries have been subjected to examination and test by Gadd,[1] who inoculated tea stems with them. He was unable to detect the presence of the ambrosia fungus some months after the inoculation. The only other fungi obtained from galleries were those producing stains, and these after inoculation also produced stains — but they showed no signs of developing a rot.

The staining of the wood round shot-hole borer galleries in tea is not only common but invariable. Similar staining, in fact, is the rule with all the bark-boring family in wood. If the stain is really the precursor of wood rot, all branches attacked should develop it. They do not. In fact, careful experiment has entirely failed to demonstrate any connection between wood-rot and shot-hole borer galleries; and, on the other hand, no evidence has been brought forward to support that connection.

The third way in which shot-hole borer attack might lead to the subsequent development of wood-rot is through fracture of a branch made weak at some spot by gallery formation. The surface in such a case may be considerably increased over a cleanly cut one by the brush of fibres standing out, and so the chances of catching a spore are increased. These branches, however, are usually small, for the most part about one-third of an inch or less. It is not at all common to find such small branches developing wood-rot and although the chances of starting on a rough break may be considered greater than on a clean cut, the probability of it happening still remains very low, and in practice these examples are very difficult to find.

We have seen above that no connection has been observed to exist between those bark-beetles which are well known to foresters as pests, and wood-rot. There is no more evidence to connect it with the tea shot-hole borer in particular. The conclusion reached, therefore, is that if the beetle is responsible at all for the development of wood-rot in the tea bush, its contribution is negligible.

REFERENCE

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RING-BARKING OF TREES, AND ROOT DISEASES

C. H. GADD

In Ceylon, Armillaria root disease of tea [1] is not common, but in Nyasaland where it is primarily a disease of jungle clearings it has caused serious losses. In Ceylon, it has occasionally been found in old tea not known to have been attacked previously by this disease, and in only one instance is it known to have caused serious loss in a jungle clearing. The latter case demonstrated how destructive the disease can be under favourable conditions.

In all cases investigated, the disease has been found to be closely associated with old tree stumps and their roots; often, the root causing infection has been located many feet below the soil surface. One method of minimising the risk of subsequent infection of tea on newly opened forest land is by thorough stumping and root clearing. There is, however, an economic limit to this process and it has been found, in Nyasaland, that although this extra cost of opening reduced the incidence of the disease, it by no means ensured complete protection. The losses, even when stumping and root clearing were employed as far as was practicable and economic, forced Leach [5] to the conclusion that such control measures were far from satisfactory.

Observations made while studying this disease suggested to him a new method of control. Briefly, it was that the incidence of Armillaria in tea clearings would be reduced if the jungle trees were killed by ring-barking before felling. The connection between ring-barking of jungle trees and the incidence of root disease in the crop grown later on the jungle site may not be immediately apparent, so a short consideration of the evidence on which his idea was founded is necessary.

Armillaria mellea requires media containing easily available carbohydrates for its satisfactory development in culture. Examinations of infected tea seedling roots showed that the invading hyphae grew most freely towards the wood and pith where the starch reserve is stored, whereas the cortex (bark) is devoid of starch. It followed, therefore, that if the starch reserves of the roots could be depleted before the trees are felled, the roots would form a less favourable

medium for the growth of the fungus, and consequently, the incidence of the disease would diminish. The most obvious method of depleting the reserves of food in the roots is by ring-barking, for reasons given later.

The roots of 'Muula' trees (*Parinarium mobola*) are considered to be the commonest source of Armillaria infection to tea on newly cleared forest land in Nyasaland. Healthy "Muula" roots contain abundant starch but when such trees become defoliated as a result of ringing, their roots are devoid of starch.

To test his hypothesis, Leach examined the roots of 24 dead stumps of 'Muula' trees which had been felled without ringing. Only three of those stumps were found to have roots free of infection by Armillaria. A similar examination of the roots of 12 stumps of 'Muula' trees which had been killed by ringing before felling disclosed no root infected by Armillaria, though he entertained some doubt about one. These observations demonstrated beyond doubt that by ringing the trees before felling, later infections of the roots by *Armillaria mellea* could be materially reduced, if not eliminated entirely.

The roots which were not attacked by Armillaria were almost invariably invaded by other fungi, the identity of all of which could not be ascertained. These roots Leach termed 'dry rotted' to distinguish them from the 'Armillaria rotted' roots. Of course, amongst the fungi causing dry rot of the 'Muula' roots might be some which could themselves become active parasites of tea, but his attempts to cause infection of tea seedlings by means of such roots all failed. He therefore concluded that the roots of forest trees killed by ringing for the control of Armillaria cannot be considered a danger to the health of the subsequent economic crop.

Ring-barking entails the cutting off of a wide strip of bark down to the wood in a complete ring round the trunk. The removal of this strip of bark in no way interferes with the upward movement, from roots to leaves, of water containing raw food materials in solution, but it completely breaks the channels down which the elaborated foods are passed from the leaves to the roots. The position immediately after ring-barking, is that the leaves are being supplied with water and other requirements from the roots but the food supply to the roots has been cut off. The roots, therefore, are forced to exist on their reserves, which includes starch, and when these are exhausted, the roots die of starvation. When this happens, the roots no longer absorb water and pass it to the leaves, so the leaves and the branches then die of water shortage as during drought.

It is imperative when attempting to kill a tree by ring-barking to suppress rigorously all growth arising below the ring and carrying leaves. Also, if the tree tends to regenerate the bark over the ringed area the new growth must be removed. To prevent this regeneration it may be necessary with some species, to cut a little way into the sap wood. The cut, however, must not be deep, otherwise the water channels from the root to the leaves will be severed and the crown will die before the roots as though the tree had been felled. The objects of ring-barking must be kept in mind. They are to deplete the roots of food reserves and to hasten the death of the root system relative to the death of the crown.

The rate at which trees die after ring-barking depends largely upon the amount of foods stored as reserves in the roots. Some trees, such as tea, use the roots as the main storage region; others store most of their reserves in the trunk and branches. Obviously, trees with large reserves in the root will take longer to kill by starvation than those which have little or no reserve. In dealing with trees which die slowly after ring-barking, it may be safe to fell them one year after ringing, because the roots would then be so depleted of carbohydrates that the roots would die rapidly after felling.

In a later paper [6] Leach has also demonstrated that in Nyasaland nearly all species in a mixed forest are susceptible to Armillaria after the roots are severed. Nevertheless, only a few species are usually a source of infection of this disease to tea. The species of trees he considered most dangerous as a source of infection by Armillaria, are those of which the roots die very slowly after felling. The slow-dying roots are rich in food reserves including starch, and so form favourable media for the growth of Armillaria. He, however, puts forward another explanation for the connection between Armillaria and roots of felled trees, which is of greater importance when the value of ring-barking is considered as a means of prevention of other diseases associated with the roots of felled stumps. It is that, once dead and invaded by saprophytes, these quick-dying roots cannot be attacked by Armillaria.

That such antagonisms might occur between the fungi which invade the roots of felled trees was suggested by the writer in a previous article.[2] Leach, however, has clearly demonstrated that such antagonism does occur between the saprophytes which invade dead roots and the parasite Armillaria, though he makes no claim that similar antagonisms occur where parasites other than Armillaria are concerned.

As an illustration of the antagonism found to occur between Armillaria and other wood invading fungi, one experiment only need

be described. Leach left a set of woody tea prunings on the top of the soil for a month so that they became invaded by various saprophytes. These dead prunings were then buried in the soil alongside a set of fresh woody prunings. Roots of Gliricidia infected with Armillaria were placed in contact with both sets of prunings as a source of infection. After burial for a month, the fresh prunings were heavily infected by Armillaria while the dead prunings were quite free. The dead prunings had an equal chance of infection, and the inability of Armillaria to enter these prunings can be attributed to the presence of other fungi already in them which prohibited its entry. There was no question of any difference in starch content of the two sets of prunings.

Similar antagonisms between fungi have been noted by other writers. Garrett [4] has used the terms *Soil inhabitants* and *Soil invaders* as a basis of ecological classification of the root infecting fungi. "The *soil inhabitants* are considered to be primitive or unspecialised parasites with a wide host range; these fungi are distributed throughout the soil, and their parasitism appears to be incidental to their saprophytic existence as members of the general soil microflora. The *soil invaders*, to which class the majority of root-infecting fungi seem to belong are more highly specialised parasites; the presence of such fungi in the soil is generally closely associated with that of their host plants. In the continued absence of a host plant, such fungi die out in the soil, owing to their inability to compete with the soil saprophytes for an existence on non-living organic matter. This close association between the *soil invaders* and their host plants thus seems to be enforced by the competition of the general soil microflora."

The problem of unwanted roots, no matter whether they are those left in the ground when jungle is cleared, or are the remains of shade trees felled in old tea, is how to ensure their decay without the intervention of a parasitic fungus liable to attack living tea roots. To use Garrett's terms it is one of getting the soil inhabitants into those roots before the soil invaders can get there. Leach's work has demonstrated that ring-barking of trees favours the entry of the soil inhabitants to the detriment of soil invaders, in particular *A. mellea*.

The problem of old roots in jungle clearings is not quite the same as the related one of roots left in old tea when shade trees are removed. In a clearing, the soil contains a dense network of old jungle roots, many of which may already be infected by one or more fungi parasitic on tea. There may be very little evidence of this infection when the jungle is cut, as the parasites are in equilibrium with their hosts. In Nyasaland, Leach has found that the percentage of trees killed by Armillaria in virgin forest is very

small, even in a pure stand of susceptible species; yet when the forest is cut down the roots of these species become invaded by Armillaria to an amazing extent. This implies that once the trunk is felled, the high degree of resistance of the roots is broken down, and the fungus spreads along the roots which then form sources of infection for the tea planted later.

In Ceylon, the disease which commonly occurs in jungle clearings is that caused by *Poria hypolateritia*, but a preliminary examination of the standing jungle gives little or no indication of the places where the disease may be expected when tea is planted. In this respect, Ceylon experience with Poria is on par with Leach's statement concerning Armillaria in Nyasaland. Moreover, in Ceylon there is practically no evidence that new centres of Poria infection are started from spores. Evidence is accumulating to show that the diseases which occur in jungle clearings are already there on the jungle roots at the time the trees are felled, and it is from these sources that the subsequent diseased areas of the later planted crop plant orignate. Infection is from the jungle roots.

In old tea the root position is different. The old jungle roots have almost entirely disappeared. In areas originally planted on grass land (patna) there has never been the problem of jungle roots, yet when shade trees are felled there is liability to root disease orginating at the stump and passing to the tea bushes whose roots are in direct contact with the stump roots. The affected tea bushes often mark out the underground lie of the stump roots.

The writer [3] has recorded some interesting data from an estate which felled about 6,000 Grevillea trees which had been grown as shade for tea. About two years after felling 30 per cent of the stumps had given rise to Brown root disease with the result that over 3,000 tea bushes had to be removed. The source of infection was attributed to wind carried spores which presumably found lodgment on the cut surfaces of the stumps.

Garrett [4] has rightly pointed out that evidence is lacking that *Fomes noxius*, the fungus which causes Brown root disease, is at all a frequent coloniser of cut wood surfaces. The absence of that evidence is held to throw some doubt on the validity of the explanation, viz. spore infection. The writer was aware that his explanation was not entirely satisfactory. He pointed out that an infection of 30 per cent of the stumps implied an immensely heavy spore dispersal which could not be accounted for satisfactorily, as fructifications of *F. noxius* are not common, and that 2 years is a surprisingly short period for the mycelium to permeate the stump and its roots, and to pass to and kill tea roots.

The difficulty of finding a more satisfactory explanation, however, still remains. The trees and the tea bushes were undoubtedly healthy at the time they were cut. The dying tea bushes occurred only around infected stumps and the trees which were not felled remained healthy. There were no old jungle roots on which suspicion might fall. If we are to discard the hypothesis of spore infection in favour of one involving underground infection of the stump roots, then *F. noxius* must have been living freely in the soil or was already established on roots of either Grevillea or tea. But there is no more evidence in favour of those alternatives than there is for spore infection. In time, no doubt, the true explanation will be found.

Because of the risk from spore infections the writer recommended that when shade trees have to be removed from old tea, no exposed wood surfaces should be left for spores to lodge on. This can usually be done by severing the lateral roots and removing the stump by cutting the taproot below ground level. When the stumps are very large their complete removal is not always practicable; then the bark should be removed and the exposed wood painted with tar. These methods are designed to prevent infection from the air, but of course, they do nothing towards prevention of infection from below ground.

Leach's work with Armillaria suggests that a further precaution against infection of tree stumps can be made by ring-barking the trees twelve months before felling. Infections from below ground may thereby be reduced.

A tea estate in an up-country district, in 1930, ring-barked 1,752 Grevillea trees growing along roadsides, over an area of 45 acres. The dead trees were not felled until 1939 when they were cut at a height of 3 to 4 feet, but so far, there has been no case of root disease in the tea associated with these tree roots. These results are not strictly comparable with those quoted above. The estates are situated in different districts and there is no knowledge of what would have occurred in either case had other treatments been applied. For instance, in the area where root disease occurred we do not know whether the amount would have been less had some of the trees been ring-barked before felling; nor do we know whether any disease would have occurred in the other area had the trees been felled without previous ring-barking. The figures quoted were not obtained from scientific experiment but are records kept by estate superintendents of work done in the course of estate management. Nevertheless the figures are not without interest.

It is unusual for as many as 1,750 trees to be felled without that operation being followed by even a small amount of root disease. The trees perhaps have not been felled long enough for the disease to become evident if infection occurs on the cut surface of the tree stump as was suggested from the observations (2 years) made on the estate where Brown root disease occurred. The trees, however, have been standing dead long enough for root infections to have occurred if underground infections of tree stumps is the rule, unless, and this seems to be probable from the foregoing, ring-barking has diminished the risk of infection of the stump roots from all sources.

What, however, is clear is that killing trees by ring-barking before felling does not materially increase the risk of subsequent root diseases. In fact the opposite is more probable; ring-barking before felling diminishes that risk, not only so far as *A. mellea* is concerned as Leach has shown, but where other root parasites, though not necessarily all of them, make their attacks on living bushes from the roots of tree stumps. The method is so simple and inexpensive that it is well worth trial whenever shade trees have to be cut out. It would be well, however, to maintain the practice of eliminating exposed wood surfaces after felling also.

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REPORT ON THE SMALL-HOLDINGS COMPETITION IN THE CENTRAL PROVINCE—1940

T. EDEN

The competition was restricted to holdings in two Korales; the Meda Palata Korale of Uda-Nuwara and the Ganga Thala Korale of Uda-Palata. The final selection was made during the week beginning June 17th and the award of prizes took place at Kirinde Government School on July 21st. The Director and the Agricultural Chemist, who judged the competition, attended. The final selection was made from a list of forty holdings.

GENERAL PROGRESS

The two Korales in question had previously entered for a similar competition in 1936. The incentive which the frequent visits of the Small-Holdings Officer and that competition had produced was quite marked even after an interval of three years during which other districts claimed the bulk of the officer's time. In particular, the need for efficient drainage of the reverse slope or lock and spill type seems to have become universally recognised. The inspection was made a month after the severe rains and floods of mid-May and the permanent damage and loss due to erosion was small. Further, great progress has been made in the use of shade trees. Those planted at the beginning of the campaign are now yielding quantities of loppings that make an effective contribution to the maintenance of fertility, and thus justify the advocated policy of green manuring. In some cases better results would have been attained by greater care in lopping, and in others difficulty had arisen because of depradations by unauthorised persons in search of goat fodder.

COMPETITIVE GREEN MANURING

To set against this marked improvement in the use of green manures, a more recent tendency requires notice. In connection with the Food Production Scheme adopted by the Ministry of Agriculture, villagers are issued with certain quantities of artificial fertilizers for the improvement of paddy lands. I was informed

that one of the necessary conditions for participation in this free issue was evidence of green manuring and other adequate cultivation operations. Whilst this stipulation is all to the good for the promotion of sound agricultural practice it has had one deplorable result. Since the Tea Research Institute has apparently been more successful than the Department of Agriculture in persuading smallholders of the value of green manuring, it invariably happened that where tea and paddy adjoined, the loppings from the tea area were transported to the paddy fields and used there. If this practice is to continue in the interests of paddy cultivation, some modification should be provided in the interests of the tea areas. At the elevation of Gampola, well-tended shade trees should produce more loppings per annum than coincide with normal cultivation operations. Loppings that are not forked in might, under the circumstances, be used on paddy fields if a corresponding return is made in the following way. The straw from the Yala harvest is shorter and more liable to climatic damage than that from the Maha harvest and is frequently burned on the fields on account of its poorer quality. This is wasteful. If moved to the tea holdings and used as a mulch, it can subsequently be forked in, mixed with an equal quantity of fresh green manure loppings. Such a system preserves the balance in husbandry, so desirable on general grounds, and the use of weathered straw and green manures together prevents the harmful effects that follow the use of straw alone. According to my observations there is frequently enough land bordering the paddy fields for use in growing live hedges of green manure. Such a course might be advocated and encouraged by agricultural instructors dealing with paddy cultivation. Otherwise the Tea Research Institute and the Department of Agriculture will be working at cross-purposes.

INTERPLANTING

Another result of the intensification of food production has been the increase in intercropping of tea small-holdings. The most usual food crop is manioc. This makes even more imperative the maximum use of green manure on the holding itself.

PRUNING AND PLUCKING

Good work in both pruning and plucking was to be found on some holdings, but anything like a progressive policy in this direction is hampered by the vagaries of bought-leaf prices. On many holdings a period of plucking, when prices are relatively favourable, is followed by a period of resting when such is not the case. This in turn may last two or three months and then plucking is started

again without any definite breaking back to a properly formed plucking table. There does not seem to be any solution to this problem, for the small-holder is here altogether in the hands of the buyer of his leaf. More and more small-holders are now leaving their tea unplucked, and the bushes are undoubtedly benefitting by being so treated.

ABANDONED HOLDINGS

My survey of the holdings convinces me that good husbandry for its own sake, and for the sake of ultimate pecuniary benefit, is making definite headway on many holdings. On the other hand one wonders whether the Tea Controller's Department has any real appreciation of the extent of the anomaly that the system of standard assessment has produced. Many holdings were seen during the inspection which were smothered in illuk, and in which not ten per cent of the acreage was occupied by tea. The amount of purely fictitious coupon value that is annually being realised on such holdings constitutes a veritable scandal, and places a heavy premium on bad husbandry. In the face of such a situation the serious attempts to improve their holdings manifested by the competitors is very commendable and a tribute to the efforts of the officer-in-charge.

PRIZE-WINNERS

Uda-Nuwara, Meda Palata Korale.

	Name	Area	Wasama
1st Prize	L. M. Samarakoon	1-0-0	Talawatura
2nd ,,	E. M. Loku Appu	0-3-0	Embekka
3rd ,,	P. N. Saranelis	1-0-0	Mugatiyapola
Commended:	J. M. Wijeratna Banda	2-0-0	Wegiriya

Uda-Palata, Ganga Thala Korale.

	Name	Area	Wasama
1st Prize	S. V. Sithambaram	3-2-0	Ulapane
2nd ,,	Mary Stewart	1-2-0	Herakola
	G. V. Muthuwa	0-3-0	Herakola
3rd ,,	D. G. Siriwardhana	0-2-22	Pellepitiya
Commended:	Kiripitige Charles Rovel	1-0-0	Giraulla

INDIAN TEA—ITS CULTURE AND MANUFACTURE*

(REVIEW)

T. EDEN

"Bald's Indian Tea" is one of the few standard text-books on tea culture and manufacture. As far back as 1922 four editions had already appeared. Since that date the tea industry has seen many changes, notably in the increased output of research and the gradual dissemination of scientific information about all the stages of production. A new edition, the fifth, is therefore timely, and it is both fitting and a sign of the times that the revision that has accompanied the new edition should be in the capable hands of Mr. C. J. Harrison, a member of the Indian Tea Association's Research Staff at the Tocklai Experiment Station.

Much of the text has been rewritten, but the general plan of the book remains the same. Such a revision is an especially difficult task; more difficult perhaps than writing an entirely new book, but it has been done with great success and makes pleasant and easy reading. In spite of the fact that scientific considerations receive more attention than previously, Mr. Harrison has succeeded in introducing them without an undue recourse to scientific jargon. There is always a danger that in describing technical processes in non-technical language, an author may sacrifice accuracy in order to use a simple or telling analogy. We have detected only two analogies which we consider are not altogether happy. In the preparation of compost by the 'Adco' process the chemical reagent used is referred to as a 'starter' (p. 109). To us this seems to be an over-simplification of the function of the reagent which is to provide both a balanced food for the rapidly increasing population of micro-organisms involved in the process, and also a substantial contribution to the ultimate manurial value of the compost. The word 'accelerator' has been used by the originators of the process. This seems to us a better description. Nor do we subscribe to the

* Bald's Indian Tea.—Its Culture and Manufacture, 5th Edition. Edited and revised by C. J. Harrison. Thacker Spink & Co. (1933) Ltd., Calcutta Rs. 15.

anthropomorphic idea of 'shock' following heavy pruning. A check in growth there is bound to be, because the plant has to mobilize its stored reserves for purposes of new growth, but in our view the word shock, associated as it is with the idea of a disorganisation of a nervous system, is best avoided.

The scope of the book is wide and every aspect of practical tea culture and manufacture is dealt with from the very first planting operations to the packing of the final produce. There are also chapters on the soils of N.E. India, soil erosion, roads, buildings, machinery and on forestry in relation to tea estates. Just enough detailed technical information is given to show the fundamental principles on which practice is based, and to make clear the fact that tea culture and manufacture is a scientific process and not a black art.

Though this book deals with N.E. India it can be read with profit by all interested in tea. Mr. Harrison occasionally draws a comparison between methods in India and Ceylon. Readers will note differences as well as similarities. We do not associate red spider attack with rainy weather (p. 226); the system of plucking hard on to the fish leaf throughout the pruning cycle is one which has never met with enthusiasm here; we believe that the use of lopped green manures has conferred considerable benefit on Ceylon tea.

In these days when improved planting material is receiving special attention the chapters on nurseries and seed bearers should be borne carefully in mind. There is no doubt that Ceylon has much to learn from India in respect of both these subjects.

There is a great deal of difference between manufacture in Ceylon and in India. The weather, the distribution of the crop throughout the season, and the class of tea aimed at in the two countries are the chief causes of the dissimilarity, but readers will find the same emphasis placed on the need for careful supervision of individual processes under Indian conditions as under ours. We should find the lighter withers of N. E. India embarrassing, but care to obtain evenness is a common requirement. The same kind of differences and similarities apply to rolling, fermenting, and firing, with emphasis on overheating, air-circulation, cleanliness, and even charging, respectively.

In a short review it is impossible to do justice to the merits of this book and to the care exercised in its preparation and production. In nearly every particular it is thoroughly up-to-date. We notice, however, that the section on capillarity of soils has been carried over

unchanged from the previous edition. The researches of the last few years have definitely shown that the effective removal of water from a water table by capillarity does not exceed a distance of six feet, and Bald's figure of 28 feet is now an anachronism (p. 24). In the next printing which we hope will soon be called for, this section might be reviewed, and a correction made of the only misprint we have noticed in a book of 471 pages, a veritable triumph of editorial patience in Eastern proof reading: *Glyricidia maculeata* (p. 130) should be *Gliricidia maculata*. The specific name *sepium* in place of *maculata* would be more in keeping with a recent international ruling on the difficult subject of botanical nomenclature.

MINUTES OF A MEETING OF THE BOARD OF THE TEA RESEARCH INSTITUTE OF CEYLON HELD 26-7-40

Minutes of a Meeting of the Board of the Tea Research Institute of Ceylon held at the Ceylon Chamber of Commerce Rooms, Colombo, on Friday, 26th July, 1940, at 2-30 p.m.

Present.—The Chairman, T. R. I. (Mr. James Forbes), the acting Financial Secretary (Mr. C. H. Collins, C.C.S.), the Director of Agriculture (Mr. E. Rodrigo, C.C.S.), the Chairman, P. A. of Ceylon (Mr. R. C. Scott), the Chairman, C.E.P.A. (Mr. C. H. Bois), Mr. R. G. Coombe, Major J. W. Oldfield, C.M.G., O.B.E., M.C., Mr. J. C. Kelly, Mr. T. B. Panabokke, First Adigar, Mr. S. F. H. Perera, and Dr. R. V. Norris (Director and Secretary).

Dr. C. H. Gadd (Mycologist) was also present by invitation.

Letters expressing inability to attend had been received from Mr. R. Gregor, and Mr. W. H. Gourlay.

1. The Notice calling the meeting was read.

2. The Minutes of the Meeting of the Board held on the 12th April, 1940, were confirmed.

3. MEMBERSHIP OF THE BOARD AND COMMITTEES

On behalf of the Board, the Chairman warmly congratulated Mr. T. B. Panabokke on his recent appointment as First Adigar.

4. FINANCE

(i). *Institute's Accounts to 30th June, 1940.*—The Chairman said the position was normal; of the sum shewn under fixed deposit, Rs. 75,000 would be utilised in September for loan payments and he thought the right policy would be to place on fixed deposit for one year any surplus funds available against the 1941 loan payments.

In regard to receipts, the estimate for the cess would probably be realised in spite of the export quota being reduced to 90 per cent. In the estimates a figure of 92½ per cent had been assumed, whereas until 31st March the actual figure was 95 per cent, and exports had been heavy. Owing to the severe drought in Dimbula, St. Coombs crop was likely to be about 10,000 pounds short, and there would probably therefore be a shortfall in estate profits. The present deficit shewn was, however, only due to outstanding invoices for which the proceeds had not yet been received.

The Board approved the Chairman's suggestion and accepted the June Accounts.

(ii). *General Financial Position.*—The Chairman said the question of the future financial policy had been discussed by the Finance Committee.

The opinion was that the present programme should be carried on but any new expenditure very carefully scrutinised. In particular, capital expenditure should be avoided as far as possible. In regard to the research side this presented little difficulty. On the estate, however, there was urgent need for additional lines, and the Finance Committee considered this expenditure would have to be met. Some 12 rooms would be required. The Finance Committee recommended these should be of the latest type and preferably in small groups.

Mr. Kelly urged that as the expenditure would have to be met, the work should be put in hand in the present year as building rates were likely to increase rather than decrease.

After discussion there was general agreement that estimates should be prepared at once for twelve line rooms of the cottage type.

Mr. Coombe suggested that the use of Mangalore tiles instead of tagarams and the substitution of some of the roof iron work by suitably treated timber should be considered. He also thought the use of concrete bricks instead of stone might be advantageous, the necessary machine for making these could be obtained for some Rs. 40—60.

The Chairman said these suggestions would be considered and the Finance Committee was given authority to sanction the necessary expenditure after detailed estimates had been presented.

The Board also approved the general policy in regard to finance outlined by the Chairman.

5. ST. COOMBS ESTATE

Visiting Agent's report dated 25th June, 1940.

6. MINUTES OF THE ESTATE AND EXPERIMENTAL SUB-COMMITTEE HELD ON 6TH JULY

The Chairman suggested that items 5 and 6 should be taken together.

Pruning Cycles.—The Chairman explained that the modification in the programme was intended merely to obtain a better distribution in regard to labour. The principle that all fields except No. 1 should be brought into a 4-year programme was not affected.

The Visiting Agent's report and the Minutes of the Estate and Experimental Committee were recorded.

7. PESTS AND DISEASES

Phloem necrosis.—A progress report by Dr. Bond on the above subject was recorded.

8. SENIOR SCIENTIFIC STAFF

(i). *Leave Arrangements.*—The Chairman said that owing to the unsettled conditions the Director had abandoned his intention of taking the six months' leave due to him in Australia and New Zealand. Subject to the approval of the Board he proposed, however, to take a shorter leave, about three months from early in August, in India. While there he would take the opportunity to visit the South Indian Research Station.

These arrangements would enable Dr. Norris to return at short notice if the position deteriorated.

The Board approved these arrangements and the Chairman expressed the hope that Dr. Norris would enjoy a well-earned holiday.

(ii). The Board approved an application from Mr. Lamb, Biochemist, asking that he might receive permission to submit his name for service overseas in the event of further volunteers being called for from the C.P.R.C.

(iii). The Chairman reported that Dr. Tubbs had been wounded on active service. It was understood, however, that his injuries were not very serious, and that he was now back with his regiment in England.

9. CONTRACT FOR SUPPLY OF TEA TO THE MINISTER FOR FOOD 1940

Reported that the Institute's seal was duly affixed to the agreement with the Tea Commissioner as sanctioned by circulation of papers (Circular No. A. 11/40 dated 31st May.)

The Chairman said the Tea Commissioner had agreed to accept 3,600 lbs. B.O.P. Fannings in place of 3,600 lbs. Pekoe and that an additional 2,500 lbs. Fannings had been offered under the conditions of the Tea Commissioner's Circular No. 100.

10. ANY OTHER BUSINESS

(i). Reported that another successful Small-Holdings Competition had just been completed in the Gampola area. Dr. Eden who carried out the final judging had reported very favourably on the work done. The Chairman and other members of the Board commented on the very interesting annual reports submitted by the two Small-Holdings Officers.

(ii). *Work on the Chemistry of Tea.*—The Director said he was still without information in regard to the progress of this work. The proposal to hold a joint conference on the subject at Tocklai between representatives of Ceylon, India and Java had proved impracticable, but he would make further representations in London.

(iii). *Tea Research Institute Conference, 1941.*—The Director asked for the opinion of the Board in regard to the feasibility under existing conditions of holding the conference.

Some doubts were expressed as to whether this would be practicable. It was decided, however, that plans should be drawn up for a conference.

The meeting then concluded with a vote of thanks to the Chair.

ROLAND V. NORRIS,
Secretary.

NOTICES.

The Institute's Laboratories and Offices are situated at St. Coombs, Talawakelle, and all applications and enquiries should be addressed to the Director, Tea Research Institute, St. Coombs, Talawakelle.

Specimens and other consignments sent by rail should be forwarded to Talawakelle Station c/o Messrs. M. Y. Hemachandra & Co., Forwarding Agents. *Carriage should be pre-paid.*

Visitors' Days.—The *second* and *last* Wednesdays in each month have been set aside as Visitors' Days at St. Coombs Estate and also at the T. R. I. Sub-Station, Gonakelle Estate, Passara, when it is hoped anyone interested will visit the Stations.

Visitors at other times are welcomed, but it is requested that an appointment be made if possible.

RULES FOR THE OCCUPATION OF ST. COOMBS GUEST HOUSE

(1). The Guest House is normally intended for the use of persons visiting the Institute and St. Coombs Estate on business. Children can in no circumstances be accommodated.

(2). Permission to occupy a room for the night must be obtained from the Director in writing and, unless sufficient notice be given, accommodation cannot be guaranteed. Two double rooms are available for the use of visitors accompanied by their wives.

(3). All visitors must sign the Visitors' Book on arrival.

(4). A bedroom may not be occupied for more than one night if required by another visitor. This shall not apply to Members of the Board or of Committees meeting at St. Coombs who shall also be entitled to priority in the allocation of accommodation when on official business.

(5). Complaints or suggestions shall be entered in the book provided for the purpose and not made to the Guest House Staff.

(6). All payments due for services rendered shall be made in *cash* to the steward-in-charge and a receipt obtained from him on the official form. The scale of approved charges is posted in the building. The steward is forbidden to give credit or to accept cheques.

(7). Liquor is supplied for consumption *in the premises only*.

(8). The Institute accepts no responsibility for cash, jewellery or other valuables of any kind left in the Guest House.

(9). All breakages will be charged for at cost price.

ROLAND V. NORRIS,
Director.

The Tea Research Institute of Ceylon.

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The publications of the Tea Research Institute will be sent, free of charge, to Superintendents of Ceylon tea estates, over 10 acres in extent, and to Estate Agencies dealing with Ceylon [illegible]ister their names and addresses with *the Director, Tea R[illegible]* *St. Coombs, Talawakelle.*

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